

Citation 2 offers better performance, more space

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Cessna Aircraft's new turbofan-powered Citation 2 offers increased performance, range and cabin space over earlier Citation models while still retaining the cockpit and engineering simplicity and low operating cost of the earlier Citations.

Cessna is building both the Citation 1 and Citation 2 models at total production rate of 12 to 13 aircraft per month. The Citation 2's rate is 7.5 aircraft per month, while the Citation 1 is being produced at 5 per month. The reason for the higher Citation 2 production rate is the high initial response to the new aircraft. Orders for the Citation 2 extend into the late summer of 1980, while the Citation 1 is sold out until the fall of 1979.

Cessna intends to equalize the Citation's production rate in late 1979, while delivering 140 aircraft that year. Russell W. Meyer, Cessna's chairman and president, said: "We see the market for the Citations split 50% between the two models. The Citation 1 is less costly to buy and operate, but does not have the range or cabin space of the Citation 2."

One of the major differences between the Citation 1 and 2 is the upgraded power available from the Pratt & Whitney of Canada JT15D-4 turbofan engines rated at 2,500 lb. thrust each, compared to the 2,200 lb. thrust of the JT15D-1As powering the Citation 1.

Meyer told *Aviation Week & Space Technology* he was very satisfied with the reliability and performance of the Pratt & Whitney engines. "There were earlier problems with the engines, but they have been resolved. The premature removal rate is below 0.2 per 1,000 hr., and during May the premature engine rate was below 0.1. One of the positive features of the aircraft and engines we most commonly hear about from operators is their reliability," Meyer said. The 16-month lead time needed to change an engine delivery schedule is holding down production rates of the Citations, Meyer said.

Aside from the performance gains with the Citation 2, the newer aircraft's cabin was stretched by 3.5 ft., and 5 in. was added to the cabin height over the aisle, compared to the Citation 1. Cessna lists the number of seats available for the Citation 2 as between 8 and 12, while the Citation 1 is able to carry 7-10. For both aircraft the figures include the crew seats. Another change from the Citation 1 is the increased range of the Citation 2, achieved by the addition of more than

1,000 lb. of usable fuel, which required that the wingspan be increased to accommodate the fuel.

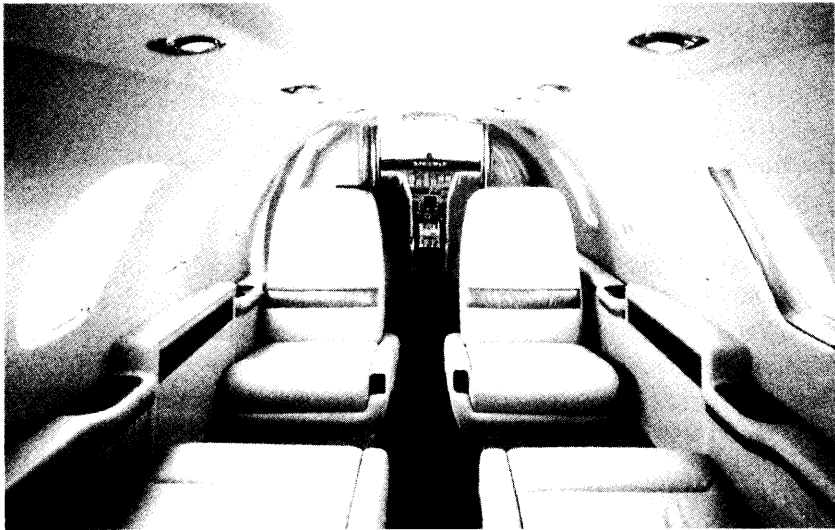
Cessna also is marketing a Citation 2 for single pilot operation, which received its Federal Aviation Administration certificate in July. Because of the slight modifications required to the basic Citation 1 and the flexibility it allowed an operator in ferry flights, or flights into noncongested areas during good weather, Citation 1 S/P (single pilot) sales have accounted for up to 80% of the Citation 1s delivered.

However, Citation 2 S/P sales have amounted to only approximately 10% of the total sales to date because of the 12,500-lb. restriction on single piloted aircraft by the FAA. The Citation 2 is certificated to Federal Aviation Regulations Part 25, while the Citation 2 S/P is certificated to Part 23. The restriction lowers the 13,500-lb. maximum gross weight of the Citation 2 to 12,700 lb. for the Citation 2 S/P, or an 800-lb. penalty in passengers or fuel.

This restriction is shown in the range of the two aircraft with six passengers and 45 min. of reserves. Range of the Citation 2 S/P is 1,508 naut. mi. with one crewmember, compared to 1,749 naut. mi. for the two-man-crew Citation 2. Payload with full fuel for the Citation 2 is 1,035 lb., and for the Citation 2 S/P is 435 lb., considering 200 lb. gained by having one pilot.



Standard Cessna Citation 2 avionics package includes a Sperry flight director/autopilot system including 4-in. conventional horizontal situation and attitude director indicators. Dual Collins VHF20A transceivers and VIR30A navigation systems are standard equipment, as is the Bendix RDR 1100 weather radar.



Cessna Aircraft Citation 2 interior is shown looking from the three-passenger rear sofa forward to the cockpit, in an eight-passenger configuration. The toilet is located behind the cockpit on the left, across from the baggage compartment, and can be isolated by two doors. Cessna also offers standard six-, eight- and ten-passenger configurations.

"The majority of operators who normally operate with two pilots anyway are not willing to sacrifice payload for the few times they may want to operate with one pilot. It is an FAA paperwork decision and nothing to do with the aircraft. In the Citation 1, the single pilot possibility works very well," Meyer said.

Another difference between the Citation 1 and the Citation 2 is the price, which amounts to \$350,000 plus or minus \$25,000. The current price of the Citation 1 is \$1,050,000, but that price is increasing to \$1,150,000 at the end of October and to \$1,250,000 in 1979.

The earlier ordered Citation 2s sold for \$1,295,000, and the aircraft to be delivered after September will cost \$1,395,000. The Citation 2 price escalates to \$1,475,000 in April, 1979, to \$1,595,000 in October, 1979, and to \$1,645,000 in April, 1980. "A Citation 2 cannot be ordered now for less than a \$1,645,000 base price, and we expect that price to increase again in October, 1980," Meyer said.

Export sales of the Citation 1 and 2 are strong in Europe, the Middle East, Far East and Venezuela, Meyer said. Of the first 20 Citation 2s to be delivered, five are for Venezuela. Meyer sees the Citation sales continuing with little abatement, while the company has no

plans to change its marketing approach, either in the U.S. or in international sales.

The evaluation of the Citation 2 by this editor was the result of two flights. The first flight was a more realistic evaluation of the aircraft during normal operations on a flight between Wichita and Boston. The second was a local flight from the Citation facility in Wichita to accomplish airwork maneuvers not accomplished during the cross-country. Both flights were flown in Citation 2 demonstrator N553CJ with Willard H. Snell, Jr. Cessna's Citation chief pilot central region.

For the first flight, the Citation 2's weight at the ramp on the 93F day in Wichita was 12,900 lb., including 4,800 lb. of fuel and two passengers. This gross weight represented 95% of the Citation 2's maximum ramp gross weight.

Using the Citation's automatic starting sequence and outside electrical power, the throttle was brought to idle at 8% turbine rpm. At 30% turbine rpm, the starter stopped functioning as a starter and worked as a generator. At idle, the fan rpm averaged 30.5% while the turbine rpm averaged 48.5%.

Following the start, and after accomplishing the pretaxi checklist, the Citation was taxied to the nearby runway at Wichita's Mid-Continent Airport. It took nearly 60% fan speed to get the aircraft rolling, but once rolling the power could be reduced for a comfortable taxi speed. Nosewheel steering is accomplished by the use of the rudder pedals, and these were found easy to handle with no shimmy, even in the tight confines of the Citation ramp area.

The V_1 takeoff decision speed was calculated to be the same as the V_r rotation speed of 107 kt., while the V_2 takeoff safety speed was 113 kt. Following the takeoff roll the aircraft's nose was rotated to 15 deg. on the attitude indicator. Federal Aviation Regulation Part 25 takeoff distance to 35 ft., considering the gross weight, field elevation and temperature, was calculated to be 4,250 ft.

Climbing through 5,000 ft. with 92.9% fan speed, the speed was 165 kt. with a 2,000-fpm climb. Cessna gives 190 kt. as the Citation 2's maximum rate of climb at sea level. Through 10,000 ft. and at the same 165 kt., the Citation 2 was climbing 1,700 fpm with a fuel burn of 800 lb./hr./engine.

Fuel flow

At 20,000 ft. and still climbing with a 100% fan speed, the fuel flow was 680 lb./hr./engine. This altitude was reached in 12 min. The initial cruising altitude of 33,000 ft. was reached in 23 min. with a total fuel burn of slightly more than 400 lb. The time to climb figures are higher

than Cessna performance figures due to air traffic control holding the aircraft at a lower altitude prior to final climb clearance, although the fuel figures are close to what Cessna predicts for the Citation 2.

The Citation 2 is equipped with a Sperry flight director/autopilot system, which includes a vertical navigation system with an altitude preselect function. This system was used for a smooth level off at 33,000 ft.

Thirty minutes after takeoff, cruising at 33,000 ft. and at maximum cruise thrust, the indicated speed was 216 kt., 460 lb./hr./engine fuel flow and a 102.4% engine fan speed. True airspeed was calculated to be 260 kt. However, the speed was still increasing, and within 2 min. it was stable at 365 kt. true airspeed. Outside air temperature was close to 10 deg. above standard.

At cruise altitude, and throughout the climb, the noise level in the cockpit was low enough to permit conversations at normal voice levels. Snell said that he has found the Citation 2 to be quieter than the Citation 1, partly because the engines are farther aft in the Citation 2. Later, sitting in the rear right cabin seat, Snell's conversation in the cockpit over the Wulfsburg Electronics Flitefone 3 in the cockpit was easily discernible.

The Citation 2's standard equipment includes dual Collins VHF 20A radios and VIR 30A navigation systems, with their combined controls located in the center instrument panel. Also included as standard is a Bendix RDR 1100 weather radar. On this flight, the weather was excellent except for a few thunderstorm buildups near the Indianapolis area, which the radar picked up with good resolution and accuracy.

N553CJ, used as a demonstrator by Cessna, included as options an Automatic Specialties (Teledyne) angle of attack indicator, Davtron Model 811B digital clock and a Jet Electronics & Technology electric standby gyro. The Sperry 4-in. flight director with a double cue presentation on the attitude director indicator is standard on the Citation 2. However, many operators are choosing the optional Sperry 5-in. attitude director with a single cue presentation, Snell said.

The Citation 2, like earlier Citation models, uses vertical tape instruments. The primary instrument for setting power, the fan rpm percentage indicator, is presented by tape and digital numbers. The turbine rpm percentage indicator, only used for engine starting, is presented in digital numbers. Internal turbine temperature, fuel flow and quantity, oil temperature and oil pressure are represented by tape displays. With more aircraft flying with the vertical displays, this editor finds, because of increased exposure, the vertical displays easy

to read quickly and helpful in determining if differences exist between the two engines.

The Citation 2 retains the simplicity in aircraft systems characteristic of the earlier Citation models. As an example, the Citations have left and right integral fuel wing tanks with individual jet pumps for each tank with a crossfeed capability in case of imbalance. During the flight there was no need to change the fuel system.

The cabin pressurization system has an 8.7 psi. nominal maximum working pressure that will give a sea level cabin to 22,842 ft. Cruising at 37,000 ft., with an 8.4 psi. pressure differential, the cabin altitude was 6,000 ft. At its maximum certificated altitude of 43,000 ft. the Citation 2's pressurization system will hold an 8,000-ft. cabin altitude.

Pressurization system

The pressurization and air conditioning system controls are located forward of the throttles, within easy reach of the pilot. Cessna had received some complaints about its automatic temperature control system in earlier Citations, and that system has been improved, Snell said.

The Citation 2's speed brakes and landing gear are the only components operated by the aircraft's 1,500-psi. hydraulic system. Rohr Industries has designed a target-type thrust reverser for the Citation 2, which, if included as an option, will operate from the hydraulic system. Slightly more than 50% of the Citation 2 operators are choosing these thrust reversers. Engine bleed air is used for anti-ice protection of the engine inlets and windshields, with a standby alcohol system available for the left windshield.

Approximately 1 hr. 45 min. after takeoff from Wichita, clearance was received from air traffic control center to climb to 37,000 ft.

The Citation series aircraft is still one of the few turboprop-powered aircraft where the maximum fan speed is set for maximum cruise thrust and the resultant cruise speed is what is flown. There is no difficulty in having to reduce power to stay at a certain Mach number. The maximum thrust can be carried from takeoff to top of descent, requiring only monitoring so the fan speed does not creep forward and exceed limits.

At 37,000 ft. and at 11,000 lb. gross weight, with a 103% fan speed, the indicated speed was 196 kt. The indicated Mach was 0.63 (the Citation 2 has a maximum Mach of 0.70). True airspeed was 360 kt.; fuel flow was 420 lb./hr./engine.

During most of the flight the Citation 2's soft ride feature was used, which gives reduced correction gain for the elevator, rudder and aileron servos while in the autopilot modes.

Navigation system

The optional Bendix RNS-3500 air navigation system, which gives bearing, distance, ground speed and time to the next station, was used on one long leg of the flight. The 32-waypoint selection system matched the other navigation systems figures to within 3 kt. and 0.2 sec. N553CJ did not have a long-range navigation system installed. However, Snell said the long-range systems being purchased by some operators are being installed in the center console, without causing the cockpit to become uncomfortable.

After 3 hr. of flight, the fan speed was 103.7%, resulting in an indicated speed of 204 kt. and Mach 0.64. The fuel flow was 450 lb./hr./engine, with 1,900 lb. of fuel remaining. The Cessna performance figures show closer to a 490 lb./hr./engine fuel flow, but with a higher indicated speed at this altitude.

Descending into Western Massachusetts, center cleared N553CJ from 37,000 ft. to be level at 14,000 ft. by a set distance from a VOR station. The vertical navigation system was used by inserting the altitude and distance inputs plus VOR station altitude and distance from station. Following the flight director command bar, the altitude restriction was missed by 80 ft., or 0.2 naut. mi.

The Citation 2's 340-deg. visibility from the cockpit was evident during the arrival at Boston's Logan Airport. The heavy traffic flow was kept in view easily during the approach. The extended landing gear was also visible. An approach speed of 120 kt. was used to keep up with the traffic, while the reference speed for the aircraft had been calculated to be 92 kt. Touchdown was at 88 kt. Maximum braking was not used during the landing at Logan. However, landing distance from 50 ft. was calculated to be 1,910 ft.

The Citation 2 was stable and responsive during the entire flight, giving the feel of a heavier aircraft. Following the 3 hr. 50 min. flight, fuel remaining at the ramp was 1,000 lb., or a 3,800 lb. fuel burn, which included taxi fuel for another 15 min. at either end of the flight.

The second flight in N553CJ, also with Snell, was flown on an early Monday morning with very little traffic in the Wichita area. The ramp gross weight of the Citation 2 was 10,610 lb., including 2,450 lb. of fuel and one passenger.

Normal engine start was accomplished and checklists completed. The Citation 2 does not have an overhead panel and starting sequence, and system checks functions are confined to the instrument panel, while circuit breakers are arranged in logical order on the forward side panels next to each pilot. The nosewheel steering was again found easy to operate and efficient in the tight confines of the Citation ramp.

For the lesser gross weight on the second flight, the V_1 was calculated to be 92 kt., V_r rotation speed was 96 kt. while V_2 was 102 kt. Following takeoff and climbing at 190 kt. with a 97.3% fan speed, the rate of climb was 2,600 fpm. The climb to 15,500 ft. took 5 min. and consumed 200 lb. of fuel, including the fuel used during a 4-min. taxi to the runway.

The Citation 2 does not have a stall warning or stick pusher system, but does have a stall strip on the inboard leading edge of the wings, which produces a slight buffet in the tail, warning of the approaching stall.

The throttles were pulled to idle and the speed brakes extended, resulting in little pitch change and no roll movement. The speed brakes automatically retract when the throttles are pushed beyond the 85% power setting on the throttle quadrant. The buffet in the tail started at 100 kt., while in the clean configuration the stall occurred at 94 kt.

Stall characteristics

With the landing gear extended and landing flaps set, the Citation 2 stalled at 78 kt. As in the clean configuration stall, the aircraft had no tendency to fall off on a wing or pitch down during the stall. A normal stall recovery was made without difficulty. The aircraft was then flown in the dirty configuration between 85 to 90 kt. in various bank angles. Taking hands from the controls, the aircraft maintained its attitude with only a slight tendency for the nose to drop from the original setting. Snell said that the more than 4 ft. added to the Citation 2's wingspan, over the Citation 1, had increased the stability of the already stable aircraft.

Descending to 5,000 ft. with a 77.5% fan speed to keep the pressurization stable, and speed brakes extended gave a comfortable 3,500 fpm descent. One coupled autopilot instrument landing system approach was made and another ILS was flown manually to Mid-Continent Airport. Following the two instrument approaches to touch-and-go landings, two visual approaches to touch-and-go landings were accomplished.

The first landing was firmer than normal as this editor searched for the runway, while subsequent landings were consistently smoother. After the first visual landing, Snell pulled the throttle on the No. 1 engine back to idle. The aircraft with takeoff power on the other engine climbed at 900 fpm at 140 kt. During the simulated one-engine-out approach and landing, power changes required little rudder trim change after the initial correction.

Snell demonstrated a short-field landing for the final approach, with a touchdown speed of 88 kt. in the first 100 ft. of the runway, re-

quiring 1,000 ft. to stop the airplane. The 1 hr. 6 min. flight, flown mostly in the landing pattern, had consumed 1,250 lb. of fuel, according to the fuel gauges.

The Citation 2 is achieving its expected performance goals, in most cases exceeding them, Snell said. The Citation 2's range is 50 naut. mi. less than expected with more than five passengers, but 50 naut. mi. farther than expected with four passengers or fewer, Snell added.

"The increased range, interior quietness and larger cabin area of the Citation 2 over earlier models impresses operators I demonstrate the aircraft to. They also appreciate the simplicity of design and low operating cost," Snell said.

Cessna estimates the direct operating cost of the Citation 2 to be \$156 per hr. in the first year under warranty, and \$196.30 per hr. after three years. The same relative figures for the Citation 1 are \$135.70 and \$159.45. These operating figures are based on an annual utilization of 500 hr.

CITATION 2 SPECIFICATIONS

POWERPLANT

Two Pratt & Whitney of Canada, Ltd., JT 15D-4 turbofan engines rated at 2,500 lb. thrust each at takeoff.

CITATION 2

WEIGHTS

Maximum ramp weight	13,500 lb. (6,124 kg.)
Maximum takeoff weight	13,300 lb. (6,033 kg.)
Maximum landing weight	12,700 lb. (5,761 kg.)
Maximum zero fuel weight	9,500 lb. (4,308 kg.)
Approx. licensed empty weight	7,066 lb. (3,205 kg.)
Maximum usable fuel capacity	5,009 lb. (2,272 kg.)
Payload with full fuel	1,035 lb. (469 kg.)

CITATION 2 S/P

WEIGHTS

Maximum ramp weight	12,700 lb. (5,761 kg.)
Maximum takeoff weight	12,500 lb. (5,670 kg.)
Maximum landing weight	12,000 lb. (5,443 kg.)
Maximum zero fuel weight	9,500 lb. (4,308 kg.)
Approx. licensed empty weight	7,066 lb. (3,205 kg.)
Maximum usable fuel capacity	5,009 lb. (2,272 kg.)
Payload with full fuel	435 lb. (197 kg.)

LIMITATIONS, BOTH AIRCRAFT

Maximum certificated altitude	43,000 ft. (13,106 meters)
Maximum operating airspeed, sea level to 14,000 ft.	262 kt. indicated
14,000 ft. to 28,000 ft.	277 kt. indicated
28,000 ft. and above	0.705 Mach
Single-engine service ceiling	23,000 ft. (26,500 ft. for S/P)

PERFORMANCE

Range with six passengers, 45 min. reserves:

Citation 2	1,749 naut. mi. (3,239 km.)
Citation 2 S/P	1,508 naut. mi. (2,793 km.)

Balanced field length, sea level, standard day

Citation 2 at 13,300 lb.	2,990 ft. (911 meters)
Citation 2 S/P at 12,500 lb.	2,650 ft. (808 meters)

Landing distance, sea level, standard day

Citation 2 at 12,700 lb.	2,270 ft. (692 meters)
Citation 2 S/P at 12,000 lb.	2,210 ft. (674 meters)

DIMENSIONS

Wing span	51.7 ft. (15.76 meters)
Length	47.2 ft. (14.4 meters)
Height	14.8 ft. (4.51 meters)
Cabin length-pressure vessel	20.9 ft. (6.37 meters)
Maximum cabin height	4.8 ft. (1.45 meters)
Maximum cabin width	4.9 ft. (1.49 meters)
Wing aspect ratio	8.28

NOISE, CITATION 2 AT 13,300 LB.

Sideline	88 epndb.
Takeoff	80 epndb.
Approach	89 epndb.